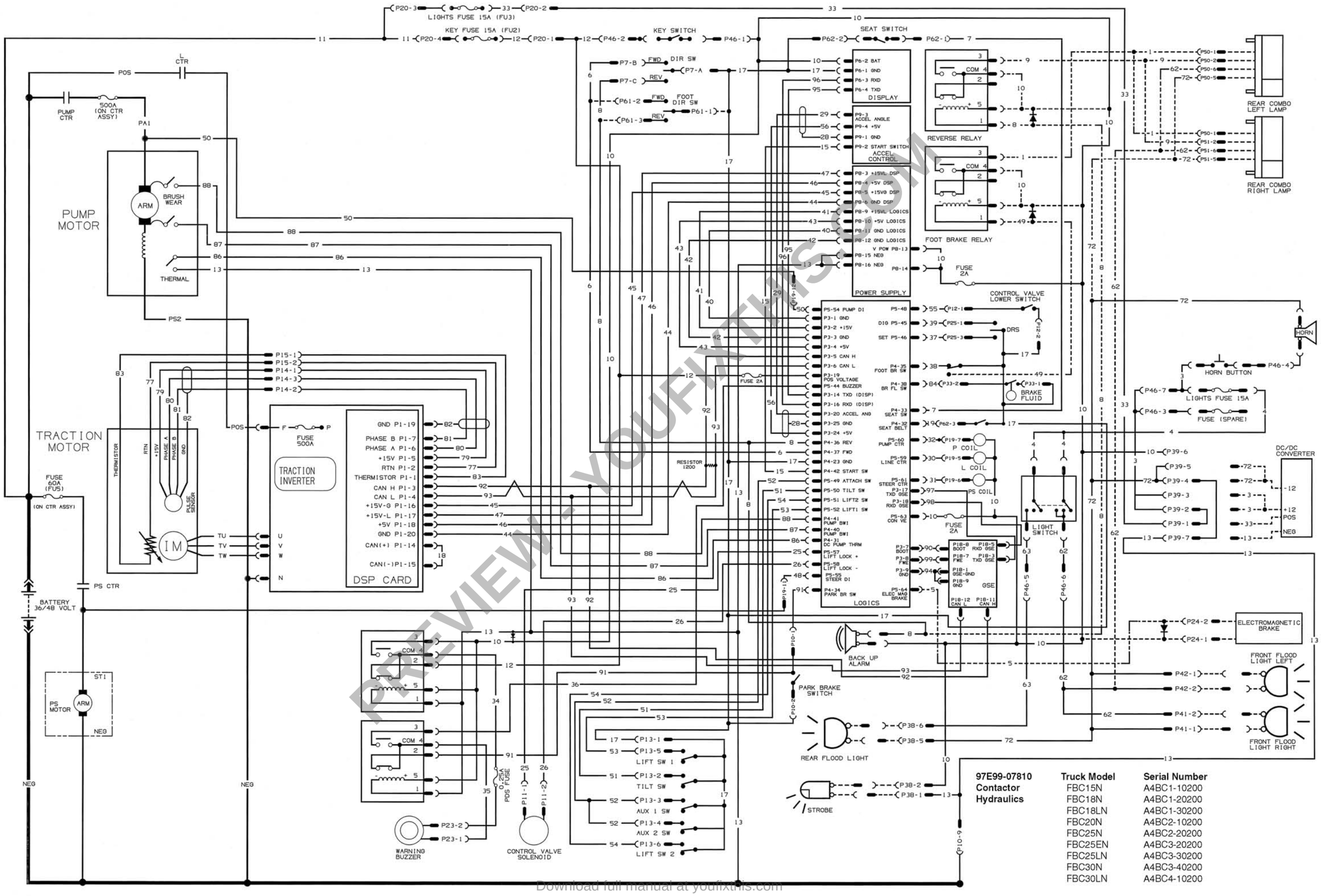


97E99-07810 Contactor Hydraulics	Truck Model	Serial Number
	FBC15N	A4BC1-10200
	FBC18N	A4BC1-20200
	FBC18LN	A4BC1-30200
	FBC20N	A4BC2-10200
	FBC25N	A4BC2-20200
	FBC25EN	A4BC3-20200
	FBC25LN	A4BC3-30200
	FBC30N	A4BC3-40200
	FBC30LN	A4BC4-10200

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Problem: Traction Motor, Overheating (E0)

(1) Situation
Controller/motor overheat indicator ON. Poor pulling power and acceleration.
Normal pump motor and power steering operations. Service tool "Alarm status" and "E0" displayed.

(2) Possible cause
Overheating of traction motor, faulty traction motor or thermal sensor, faulty or open harness wiring, faulty traction inverter DSP card, abnormal power supply of logic unit, brake or parking brake drag, abnormality in front axle, faulty display unit.

(3) How the error code is triggered
Motor temperature is out of range of -25 °C to 150 °C (-13 °F to 302 °F).
It becomes normal when motor temperature is in range of -20 °C to 70 °C (-4 °F to 158 °F).

(4) Checks
Let truck cool for 15 minutes.
Overheat indicator ON
Overheat indicator OFF

(5) Traction motor becomes normal.

If problem reoccurs

(6) Disconnect battery plug. Disengage brake and parking brake, and check their drag.
No drag
Drag

(7) Adjust brake.

(8) Lift front wheels, and disengage parking brake. Turn key switch to OFF, rotate front wheels. Confirm there is no difference in rotation load between right and left wheels.
No difference
Difference

(9) Check if truck is operated on steep upgrade or to pull large cargo load.
Normal

(10) Perform inverter discharging work. See page 1-45.

(11) Replace traction motor.
See Chassis & Mast.

(12) Replace traction motor or front axle.
See Chassis & mast.

With service tool

(13) Confirm temperature of traction motor with input/output monitor.
Less than -20 °C(-4 °F) or more than 70 °C(158 °F)
-20 °C to 70 °C (-4 °F to 158 °F)

Without service tool

(14) Disconnect battery plug. Wait until traction motor temperature becomes close to room temperature.

(15) Disconnect battery plug.

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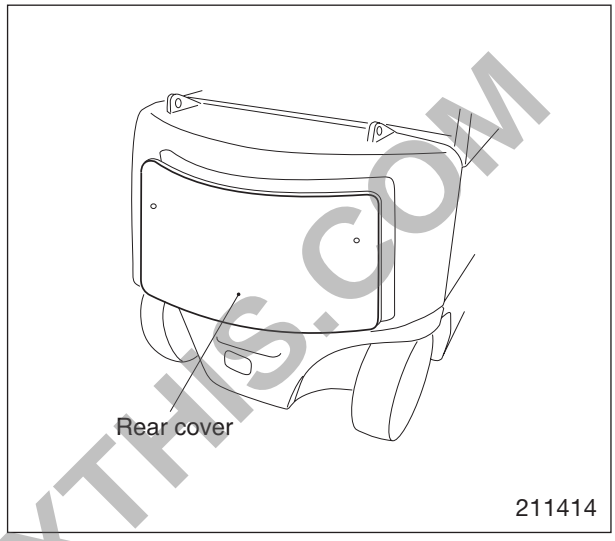
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Removal and Installation

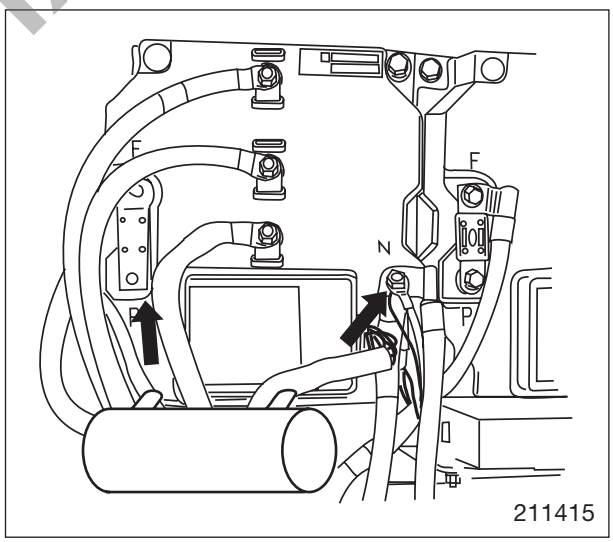
Inverter Discharging Procedure

Discharge electric charges stored in the inverters by using the following procedure.

1. Turn off the key switch.
2. Disconnect the battery plug.
3. Remove the rear cover.



4. Place a 150 Ω/25 W resistor between P and N terminals in the traction inverter to discharge electric charges stored in the inverter.
5. After touching the resistor to the P and N terminals for approx. five seconds, measure the voltage between the terminals with a multimeter and confirm a reading of 5 V or less.
6. Perform the same procedure for the pump inverter in order to discharge electric charges from all inverters.



Check whether the resistance between + and - of the battery plug on the truck side is 1 kΩ or more when connecting the battery plug for the first time after maintenance.

(Discharge electric charges completely before measuring. Longer measurement time reduces resistance value.)

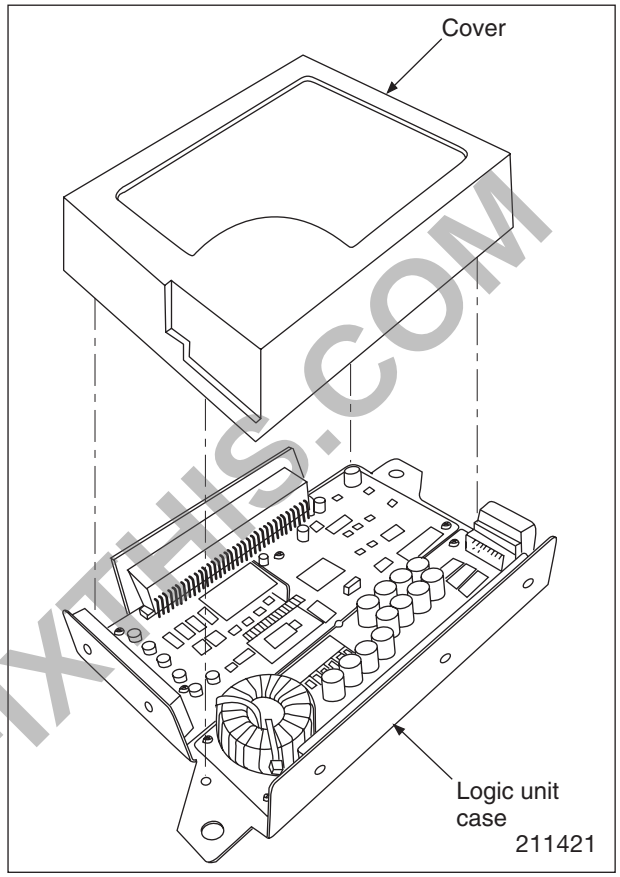
Discharge Tool 16A68-02600.

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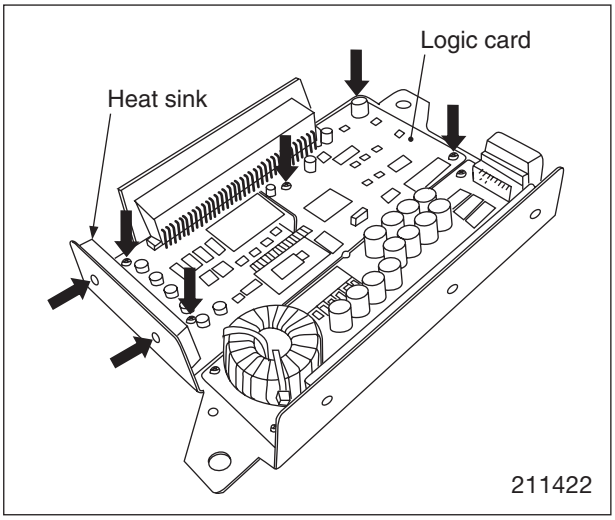
Replacing Logic Card

NOTICE: When replacing the logic card, it is recommended to replace the logic unit as an assembly.
When the cover is removed from the logic unit case, its tapped holes may be damaged. Replace the cover if the tapped holes of the cover are damaged.



Removal

1. Perform step 1 to 5 in Replacing Logic Unit.
2. Remove M3 flat head screws (four places) from the bottom of the logic unit to remove the cover.
3. Remove M3 screws (seven places) fixing the logic card to the logic unit case to remove the logic card.
4. Remove the grommet from the logic card.

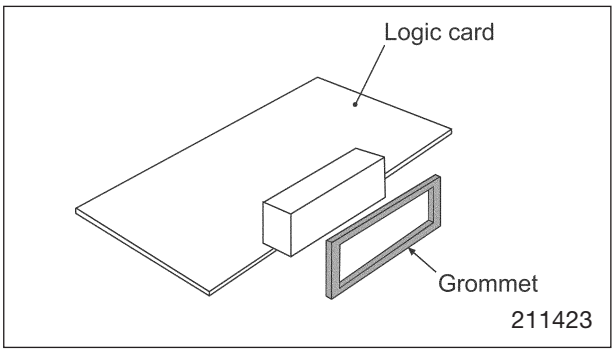


Installation

Follow the removal sequence in reverse.

⚠ CAUTION

When installing the logic card onto the logic unit case, carefully tighten the logic card and heat sink fixing screws to the specified torque to avoid excessive stresses. Repair the heat sink first.



Tightening torque

M3 screw	0.98 ± 0.20 N·m (0.10 ± 0.02 kgf·m) [0.72 ± 0.15 lbf·ft]
M3 flat head screw	0.30 ± 0.10 N·m (0.03 ± 0.01 kgf·m) [0.22 ± 0.074 lbf·ft]

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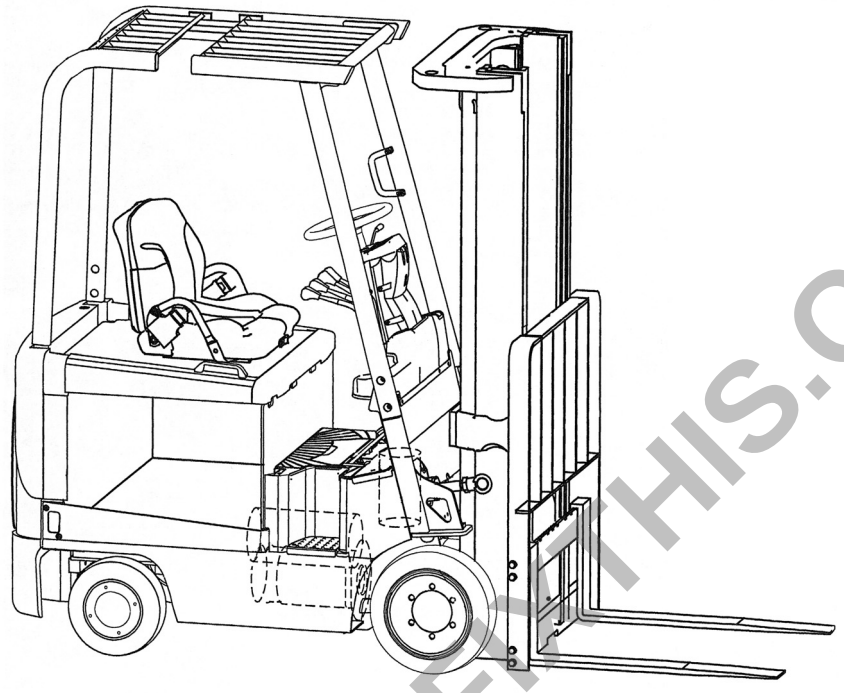
Run Time Diagnostics

Fault	How to detect	Display								Steering operation	Result	To return to normal	Memory
		LED							Code				
		Error	Brake Oil	Parking Brake	Battery Low	Over Temp.	Seat Belt	Service Indicator					
Traction Motor, Overheating	Thermistor (150°C, -25°C)					*			E0	○	Power reduction	Cool	*
Pump Motor, Overheating	Thermistor (150°C, -25°C) (Transistor Control type) Thermal SW ON (Contactor Control Type)					*			E2	○	Power reduction (Transistor Control Type) Operates 1 s only (Lift, Attachment) (Contactor Control Type)	Cool	*
Traction Inverter, Overheating	Thermistor (IMS 100°C, -25°C. Capacitor 110°C, -25°C)					*			E5	○	Power reduction	Cool	*
Pump Inverter, Overheating	Thermistor (Transistor Control Type) (IMS 100°C, -25°C. Capacitor 110°C, -25°C)					*			E7	○	Power reduction (Transistor Control Type)	Cool	*
	Thermistor (Contactor Control Type) (IMS 105°C, -25°C. Capacitor 115°C, -25°C)									○	Operates 1 s only (Lift, Attachment) (Contactor Control Type)		
Pump Motor BWI (Contactor Control Type)	Pump motor BWI SW ON	*							br	○	Operates 1 s only (Lift, Attachment)	Turn off key	*
Traction Motor Current Sensor Fault	Out of normal range	*							14	○	Line contactor Off(*) Steering contactor Hold	Turn off key	*
Traction Motor Over-current	More than 985 Arms (1.6 ms), 990 Arms (1 ms), 1018 Arms (a moment)	*							15	○	Line contactor Off Steering contactor Hold	Turn off key	*
Traction Motor Stall Timer	Measures time (set by SUO#20) while stalling.	*							16	○	Line contactor Off Steering contactor Hold	Turn off key	*
Pump Motor Current Sensor Fault (Transistor Control Type)	Out of normal range	*							34	○	Line contactor Off(*) Steering contactor Hold	Turn off key	*
Pump Motor Over-current (Transistor Control Type)	More than 985 Arms (1.6 ms), 990 Arms (1 ms), 1018 Arms (a moment)	*							35	○	Line contactor Off Steering contactor Hold	Turn off key	*
Line Contactor Fault	Checks voltage of power circuit.	*							40	○	Line contactor Off(*) Steering contactor Hold	Turn off key	*
Steering Contactor Fault	Checks voltage of power circuit.	*							41	×	Line contactor Off(*) Steering contactor Off(*)	Turn off key	*
Pump Contactor Fault (Contactor Control Type)	Checks voltage of power circuit.	*							42	○	Line contactor Off(*) Steering contactor Hold	Turn off key	*
Traction Motor Open	Traction motor open	*							45	○	Line contactor Off Steering contactor Hold	Turn off key	*
Pump Motor Open (Transistor Control Type)	Pump motor open	*							47	○	Line contactor Off Steering contactor Hold	Turn off key	*
Accelerator Sensor Fault	Accel SW ON: Below 0.3V Accel SW OFF: More than 1.41V Below 0.2V, More than 4.8V	*							51	○	Line contactor Off Steering contactor Hold	Turn off key	*
Traction Motor Pulse Input Fault	Out of normal range (5800 rpm)	*							52	○	Line contactor Off Steering contactor Hold	Turn off key	*
Pump Motor Pulse Input Fault (Transistor Control Type)	Out of normal range (4000 rpm, 2 s) With no rotation input during a current output (More than 240 Arms, 0 rpm, 1 s)	*							57	○	Line contactor Off Steering contactor Hold	Turn off key	*
Direction Lever or Accelerator, Faulty Setting	Lever/accel is not neutral at power-on and seat SW on.								E	×	Line contactor Off Steering contactor Off	Seat switch ON Direction lever is in neutral accel off	
	Seat SW is turned on after lever/accel is operated.									○	Slow down and Line contactor Off		
Seat Switch, Faulty Setting For Traction	Seat SW is off at power-on.								(E)	×	Line contactor Off Steering contactor Off	Seat switch ON Direction lever is in neutral accel off	
	Seat SW is off.									○	Slow down and Line contactor Off		
Lift Lever, Faulty Setting	Lever is not neutral at power-on and seat SW on.								H1	×	Line contactor Off Steering contactor Off	Seat switch ON Lever is in neutral	
	Seat SW is turned on after lever is operated.									○	Disables lever operation		
Tilt Lever, Faulty Setting	Lever is not neutral at power-on and seat SW on.								H2	×	Line contactor Off Steering contactor Off	Seat switch ON Lever is in neutral	
	Seat SW is turned on after lever is operated.									○	Disables lever operation		
Attachment 1 Lever, Faulty Setting	Lever is not neutral at power-on and seat SW on.								H3	×	Line contactor Off Steering contactor Off	Seat switch ON Lever is in neutral	
	Seat SW is turned on after lever is operated.									○	Disables lever operation		

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Motor Installation Positions



Specifications

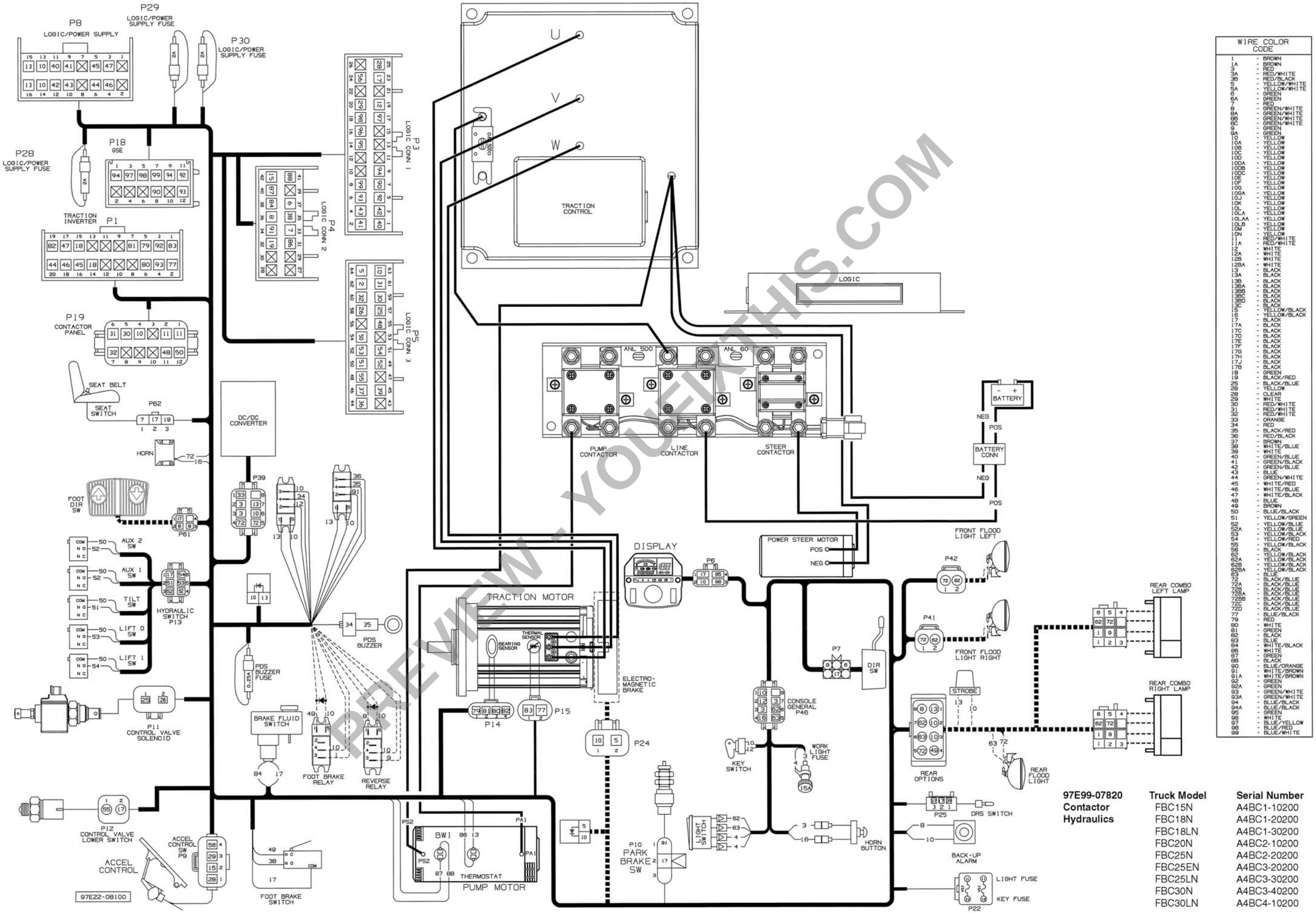
Item	9” AC Drive Motor		11” AC Drive Motor w/o Brake		11” AC Drive Motor w/ Brake	
Type	Induction three phase		Induction three phase		Induction three phase	
Voltage (V)	36	48	36	48	36	48
Output (kW)	6.16 kW (S2-60 min)	6.84 kW (S2-60 min)	10.2 kW (S2-60 min)	12.81 kW (S2-60 min)	10.2 kW (S2-60 min)	12.81 kW (S2-60 min)
Weight kg (lb)	80 (176)		136 (299)		136 (299)	

Item	8” AC Pump Motor		9” AC Pump Motor	
Type	Induction three phase		Induction three phase	
Voltage (V)	36	48	36	48
Output (kW)	7.41 kW (S3-15%)	6.84 kW (S3-15%)	10.2 kW (S3-15%)	12.81 kW (S3-15%)
Weight kg (lb)	55 (121)		75 (165)	

Item	8” DC Pump Motor		9” DC Pump Motor		DC Steering Pump Motor	
Type	Series		Series		Permanent Magnet	
Voltage (V)	36	48	36	48	36	48
Output (kW)	10 kW (S3-20%)	14 kW (S3-20%)	15.1 kW (S3-20%)	22.1 kW (S3-20%)	0.69 kW (S2-60 min)	0.93 kW (S2-60 min)
Weight kg (lb)	52 (114)		78 (172)		14 (30)	

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WIRE COLOR CODE	
1	BROWN
1A	BROWN
3	RED
3A	RED/WHITE
3B	RED/BLACK
5	YELLOW/WHITE
5A	YELLOW/WHITE
6	GREEN
6A	GREEN
7	RED
8	GREEN/WHITE
8A	GREEN/WHITE
8B	GREEN/WHITE
8C	GREEN/WHITE
9	GREEN
9A	GREEN
10	YELLOW
10A	YELLOW
10B	YELLOW
10C	YELLOW
10D	YELLOW
10DA	YELLOW
10DB	YELLOW
10DC	YELLOW
10E	YELLOW
10F	YELLOW
10G	YELLOW
10GA	YELLOW
10J	YELLOW
10K	YELLOW
10L	YELLOW
10LA	YELLOW
10LAA	YELLOW
10LB	YELLOW
10M	YELLOW
10N	YELLOW
11	RED/WHITE
11A	RED/WHITE
12	WHITE
12A	WHITE
12B	WHITE
12BA	WHITE
13	BLACK
13A	BLACK
13B	BLACK
13BA	BLACK
13BB	BLACK
13BC	BLACK
13BD	BLACK
13C	BLACK
15	YELLOW/BLACK
15A	YELLOW/BLACK
17	BLACK
17A	BLACK
17C	BLACK
17D	BLACK
17E	BLACK
17F	BLACK
17G	BLACK
17H	BLACK
17J	BLACK
17B	BLACK
18	GREEN
19	BLACK/RED
25	BLACK/BLUE
28	YELLOW
28	CLEAR
29	WHITE
30	RED/WHITE
31	RED/WHITE
32	RED/WHITE
33	ORANGE
34	RED
35	BLACK/RED
36	RED/BLACK
37	BROWN
38	WHITE/BLUE
39	WHITE
40	GREEN/BLUE
41	GREEN/BLACK
42	GREEN/BLUE
43	BLUE
44	GREEN/WHITE
45	WHITE/RED
46	WHITE/BLUE
47	WHITE/BLACK
48	BLUE
49	BROWN
50	BLUE/BLACK
51	YELLOW/GREEN
52	YELLOW/BLUE
52A	YELLOW/BLUE
53	YELLOW/BLACK
54	YELLOW/RED
55	YELLOW/BLACK
56	BLACK
62	YELLOW/BLACK
62A	YELLOW/BLACK
62B	YELLOW/BLACK
62BA	YELLOW/BLACK
63	BLUE
72	BLACK/BLUE
72A	BLACK/BLUE
72B	BLACK/BLUE
72BA	BLACK/BLUE
72BB	BLACK/BLUE
72C	BLACK/BLUE
72D	BLACK/BLUE
77	BLUE/BLACK
79	RED
80	WHITE
81	GREEN
82	BLACK
83	BLUE
84	WHITE/BLACK
86	WHITE
87	GREEN
88	BLACK
90	BLUE/ORANGE
91	WHITE/BROWN
91A	WHITE/BROWN
92	GREEN
92A	GREEN
93	GREEN/WHITE
93A	GREEN/WHITE
94	BLUE/BLACK
94A	BLUE/BLACK
95	GREEN
96	WHITE
97	BLUE/YELLOW
98	BLUE/RED
99	BLUE/WHITE

97E99-07820 Contactor Hydraulics	Truck Model	Serial Number
	FBC15N	A4BC1-10200
	FBC18N	A4BC1-20200
	FBC18LN	A4BC1-30200
	FBC20N	A4BC2-10200
	FBC25N	A4BC2-20200
	FBC25EN	A4BC3-20200
	FBC25LN	A4BC3-30200
	FBC30N	A4BC3-40200
	FBC30LN	A4BC4-10200

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Problem: Pump Motor, Overheating (Transistor Control Type) (E2)

(1) Situation
Controller/motor overheat indicator ON. Lifting speed slower than normal. Normal traction motor and power steering operations. Service tool "Alarm status" and "E2" displayed.

(2) Possible cause
Overheating of pump motor, faulty pump motor or thermal sensor, faulty or open harness wiring, faulty pump motor inverter DSP card, abnormal power supply of logic unit, abnormal oil pressure of gear pump or hydraulic lines, faulty display unit.

(3) How the error code is triggered
Motor temperature is out of range of -25 ℃ to 150 ℃ (-13 ˚F to 302 ˚F).
It becomes normal when motor temperature is in range of -20 ℃ to 70 ℃ (-4 ˚F to 158 ˚F).

(4) Checks
Let truck cool for 15 minutes.
Overheat indicator ON
Overheat indicator OFF

(5) Pump motor becomes normal.
If problem reoccurs
(6) Check if truck is operated to lift large cargo load.
Normal
(7) Perform inverter discharging work. See page 1-45.
(8) Check oil pressure of gear pump and hydraulic lines.
Normal
Abnormal
(9) Replace pump motor. See Chassis & Mast.
(10) Repair or replace gear pump or piping. See Chassis & Mast.

With service tool
Without service tool

(11) Confirm temperature of pump motor with input/output monitor.
Less than -20°C(-4 °F) or more than 70°C(158°F)
-20 ℃ to 70 ℃ (-4 ˚F to 158 ˚F)

(12) Disconnect battery plug. Wait until pump motor temperature becomes close to room temperature.
(13) Disconnect battery plug.
(14) Perform inverter discharging work. See page 1-45.
(15) Troubleshoot display unit by referring Display Communication Fault (60)-(4).
(16) Disconnect connector P17 of pump motor thermal sensor. Measure resistance between P17(78) and (89).
581 Ω at 20 ˚C(68 ˚F)
(Min. 555 Ω, Max. 607 Ω)
For resistance at temperature other than 20 ˚C(68 ˚F), see table on page 2-8.
Out of range
Thermal
(17) Disconnect connector P2 of pump motor inverter.
Check continuity between P2-1 and P17(89).
Check continuity between P2-2 and P17(78).
Continuity
No continuity
(18) Replace pump motor. See Chassis & Mast.

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Replacing DSP (Digital Signal Processor) Card

Removal

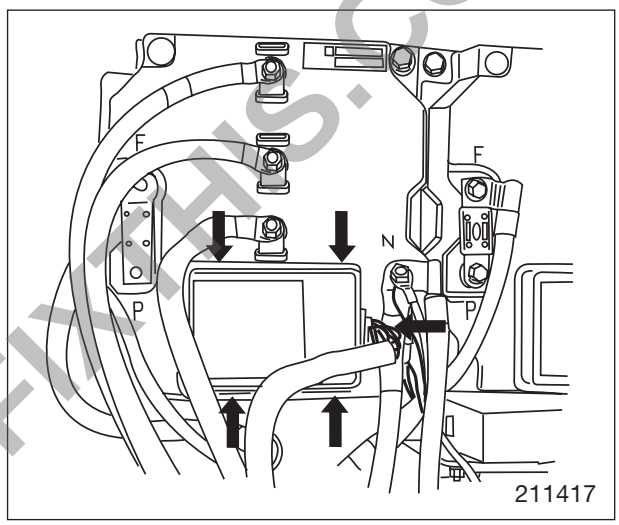
1. Perform step 1 to 5 in Inverter Discharging Procedure.

> **⚠ CAUTION**
>
> Make sure to discharge inverters before working on the electrical system.

2. Disconnect the connector.

> **⚠ CAUTION**
>
> When disconnecting the connector, hold the connector housing and plug, and unlock the connector.
>
> Holding the case may cause damage to the inside card, while holding the cable may cause wire breakage.

3. Push and lift up at the four corners of the card cover to remove the cover.



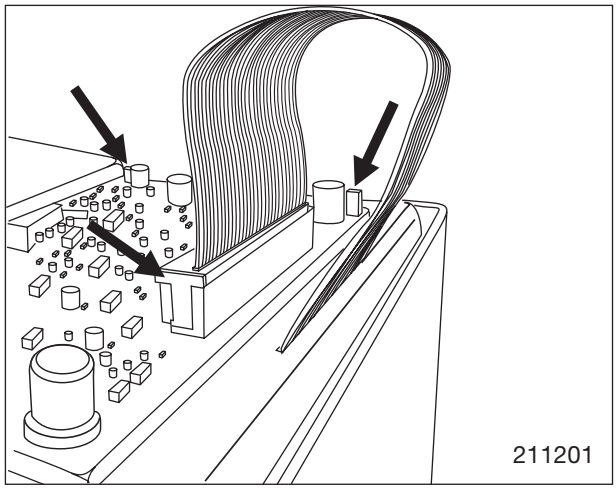
4. Unlock the connector that is connected to the flat cable.

   Hold the both ends of the white part of the connector and pull it straight up.

5. Pull the flat cable to disconnect it.

   If it cannot be disconnected smoothly, raise the lock again to unlock.

6. Pinch the plastic spacers at the four corners of the DSP card with pliers to unlock and remove the card.



> **⚠ CAUTION**
>
> Be careful not to damage mounted parts with the pliers since the card has a number of fragile parts.

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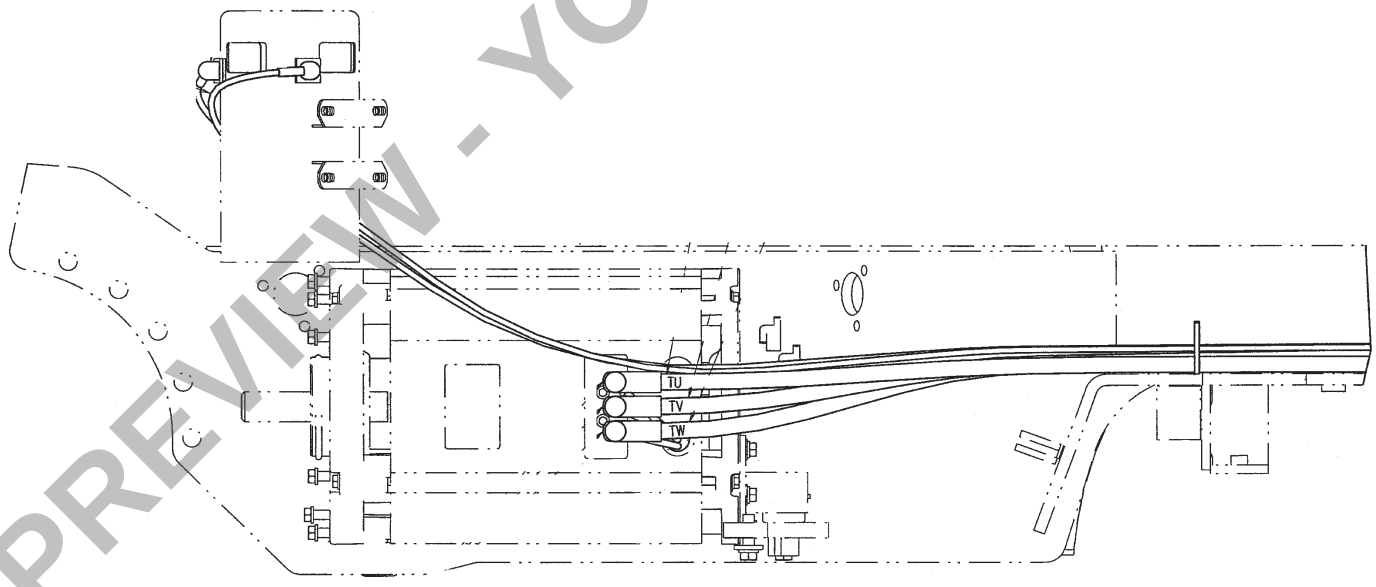
Tightening of High-Power Motor Cable Terminals

⚠ CAUTION

If the high-power cable terminals of the battery operated vehicle are not tightened properly, the increased contact resistance causes excessive heat generation, and could cause a fire in the worst case. To prevent accidents and equipment problems, be sure to regularly check the tightening torque of the high power cable terminals. Do not pull the cables to check connections or during adjustment. If the cable terminal sections are moved, re-tighten the connections.

Truck Size	Number of Terminals	Tightening Torque
1 Ton Drive & Pump	3	11.3 ± 1.1 N•m (1.2 ± 0.1 kgf•m) [8.33 lbf•ft]
2 / 3 Ton Drive & Pump	3	14.7 ± 1.1 N•m (1.5 ± 0.1 kgf•m) [11 lbf•ft]

Traction Motor & Power Steer Motor Cable Routing



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Fault	How to detect	Display								Steering operation	Result	To return to normal	Memory
		LED							Code				
		Error	Brake Oil	Parking Brake	Battery Low	Over Temp.	Seat Belt	Service Indicator					
Seat switch, Faulty Setting For Hydraulic	Seat SW is off at power-on.								(L)	×	Line contactor Off Steering contactor Off	Seat switch ON Lever is in neutral	
	Seat SW is off.									○	Disables lever operation		
Display Communication Fault	When serial communication is not going on	*							60	○	ERROR LED (!) flickers	Turn off key	*
	Display hour meter error										ERROR LED (!) lights		
Logic Card Initialize Failure	SUO Gr.#3 and default setting are not set. Inverter setting error	*							61	×	Line contactor Off Steering contactor Off	Turn off key	*
Logics Fault	Sum check of ROM Memory check of RAM Sum check of SUO data (EEPROM)	*							62	×	Line contactor Off Steering contactor Off	Turn off key	*
Traction Inverter Fault	Sum check of ROM Memory check of RAM Initial mode SW setting fault When CAN communication is not going on	*							63	×	Line contactor Off Steering contactor Off	Turn off key	*
Pump Inverter Fault	Sum check of ROM Memory check of RAM Initial mode SW setting fault When CAN communication is not going on	*							65	×	Line contactor Off Steering contactor Off	Turn off key	*
Contactor Coil Fault	Contactor coil current sensor Line contactor Pump contactor Steering contactor	*							72	×	Line contactor Off Steering contactor Off	Turn off key	*
Hydraulic Lock Solenoid Fault	Checks current of lift lock valve power circuit.	*							74	○	Disables lever operation	Turn off key	*
Electromagnetic Brake Solenoid Fault	Checks current of electromagnetic brake valve power circuit.	*							75	○	Line contactor Off Steering contactor Hold	Turn off key	*
Battery Voltage Too Low	Voltage class is not correct.	*							78	×	Line contactor Off Steering contactor Off	Turn off key	*
Battery Voltage Too High	Voltage class is not correct.	*							79	×	Line contactor Off Steering contactor Off	Turn off key	*
Battery Consumption Much	Much consumption with small capacity battery				*					○	Power reduction (economy table)	Charge battery	
Battery Consumption Too Much	Too much consumption with small capacity battery				*				(Lo)	×	Line contactor Off(*) Steering contactor Off(*)	Turn off key	
Brake Oil, Low Level	Level sensor (Contact)		*							○		Turn off key	

NOTICE: (1) E0, E2, E5 and E7 don't appear on the display, but are stored in the memory.

(2) E, (E), (L), H1-H3, and Lo appear on the display, but are not stored in the memory. (E) means flickering.

(3) "Line contactor off(*)" means that the contactor will open immediately when a fault is detected. "Line contactor off" means that the contactor will open when current goes to 0.

(4) Contactor "hold" means "no change." When the error occurs while the contactor is turned on, it stays on.

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Service Data

AC Motor

Item \ Truck Models				1 Ton Class	2 / 3 Ton Class
AC Drive Motor and Pump Motor	Stator Coil Insulation Resistance			1MΩ min.	1MΩ min.
	Terminal Conductivity (Ω)	Drive Motor	U-V	0	0
			V-W	0	0
		Pump Motor	W-U	0	0
	Cable Terminal Tightening Torque		N•m (kgf•m) [lbf•ft]	11.3 ± 1.1 N•m (1.2 ± 0.1 kgf•m) [8.33 lbf•ft]	14.7 ± 1.1 N•m (1.5 ± 0.1 kgf•m) [11 lbf•ft]

DC Motor

Item \ Truck Models			1 Ton Class	2 / 3 Ton Class
DC Pump Motor	Pump Motor	Resistance between PA1 & PS2	0 Ω	0 Ω
		Cable Terminal tightening torque	6.8 N•m 0.69kgf•m 5 lbf•ft	13.5 N•m 1.4 kgf•m 10 lbf•ft
	Steer Pump Motor	Resistance between Neg. & Pos.	0 Ω	0 Ω
		Cable Terminal tightening torque	6.8 N•m 0.69 kgf•m 5 lbf•ft	6.8 N•m 0.69 kgf•m 5 lbf•ft

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